6. CURRENT AND POTENTIAL SITE AND RESOURCE USES

The original mission of INTEC was to reprocess spent reactor fuel elements to recover highly enriched uranium. In 1992, the mission was changed and the facility no longer reprocesses spent nuclear fuels. The current mission of INTEC is to provide safe interim storage of spent nuclear fuels, provide research and development support for the disposition of these fuels in a federal geologic repository, manage other HLW, manage wastes from past reprocessing and D&D activities, and develop improved waste management techniques.

6.1 Current Land Uses

The INEEL consists of approximately 2,305 km^2 (890 mi^2) (230,266 ha [569,000 acres]). The majority of this land, approximately 98%, has not been impacted by DOE site operations. Only 2% of the INEEL has been impacted by Site operations. Past use of the INEEL as a Department of Defense target range has resulted in an area of greater than 518 km^2 (200 mi^2) contaminated by unexploded ordnance. Land uses for the entire INEEL are currently restricted and controlled. There are no areas of current residential land use within the INEEL boundaries. The typical INEEL land use consists of wildlife management areas, government industrial operations areas, and waste management areas. Some recreational use, such as hunting, is allowed in designated areas during selected periods of time which are controlled by the DOE and the Idaho Department of Fish and Game or Native American Treaties. Additionally, the DOE through the BLM leases land parcels for commercial use, such as sheep grazing.

Current land-use is government-controlled industrial use. It is termed "controlled" because there is no unrestricted public access to the INTEC and INEEL. Although there are public highways that traverse the INEEL, activities beyond the highway right-of-way are controlled and restricted by fences and security guards. For example, access to INEEL facilities require proper clearance, training, or escort and self-imposed (DOE) controls to limit the potential for unacceptable exposures.

6.2 Reasonably Anticipated Future Land Use

Planning assumptions in the INEEL Comprehensive Facility Land Use Plan (DOE-ID 1998d) are that the INEEL will remain under government management and control for at least the next 100 years. Future government management and control becomes increasingly uncertain with time. Regardless of the future use of the land now occupied by the INEEL, the federal government has an obligation to provide adequate institutional controls (i.e., limit access) to areas that pose an unacceptable health or safety risk to the public and workers until that risk diminishes to an acceptable level for any intended uses. Achievement of this obligation hinges on Congress appropriating sufficient funds to the responsible government entity charged to maintain the institutional controls for as long as necessary and as long as the federal government of the United States remains viable. No residential development (i.e., housing) will be allowed to occur within INEEL boundaries during the next 100 years. Grazing will be allowed to continue in the buffer area.

Across the INEEL it is anticipated that there will be a mix of land uses to include unrestricted industrial uses, government-controlled industrial uses, unrestricted areas, controlled areas for wildlife management and conservation, and waste management areas. However, the unrestricted areas are not planned for residential development during the next 100 years. Future land use scenarios are identified in the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995a). This document was developed using a stakeholder process that involved a public participation forum, a public comment period, and the INEEL Citizens' Advisory Board (CAB). The public participation forum membership included members from the local counties and cities, the

Shoshone-Bannock Tribes, the BLM, DOE, U.S. Forest Service, U.S. National Park Service, Idaho Department of Transportation, Idaho Fish and Game, and eight business, education, and citizen organizations. In addition, the EPA, and IDHW participated in an ex-officio capacity. Following review and comment by the public participation forum, the document underwent a 30-day public comment period and was subsequently submitted to the CAB for review and recommendations. No recommendations for residential use of any portions of the INEEL until at least year 2095 have been received to date.

Areas of the INEEL are expected to be either industrial or non-industrial for the next 100 years. In the northern area of the INEEL, potential industrial use of the land for a spaceport is being considered. The non-industrial areas are expected to involve grazing and similar activities. In addition, the INEEL is currently a National Environmental Research Park and is expected to remain so for the foreseeable future. This future use is expected to last until at least 2095.

The reasonably anticipated future use for WAG 3 until 2095 is as a government-controlled industrial facility. The industrial area is expected to involve activities such as national laboratory research and development or handling, treatment, and disposal of radioactive materials. The industrial operations assumptions include a 10-ft basement scenario. Section 11 of this document discusses institutional controls to be implemented at OU 3-13 CERCLA sites. An Institutional Control Plan for specific sites will be developed during RD. Section 21.1of the FFA/CO provides EPA site access with or without prior notification. The Institutional Control Plan will include provisions that any lease or privatization effort by DOE will include EPA access.

6.3 Basis for Future Land Use Assumptions

The projection for future land use at INTEC is based upon:

- DOE projections for the future of its national laboratory research and development activities and nuclear reactor programs
- The presence of active industrial and research facilities
- The presence of an industrial infrastructure
- No apparent non-industrial uses, other than grazing within the INEEL
- Recommendations from the INEEL CAB and other stakeholders regarding future use assumptions.

6.4 Groundwater Uses

Current SRPA groundwater use at INTEC is for drinking and irrigation. Groundwater is extracted from several production wells, which are located upgradient of WAG 3 groundwater contamination. There is no current water usage from regions of the aquifer that have been contaminated above MCLs immediately downgradient of INTEC. Future groundwater use from contaminated portions of the SRPA outside of the current INTEC security fence will be restricted by institutional controls until 2095. Following 2095, it is anticipated that groundwater in the SRPA will be available for all uses. Groundwater contamination from INTEC is not expected to migrate past INEEL boundaries. Water use restrictions during the restoration time frame will apply only inside the INEEL boundaries.

There is no current or future planned groundwater use from the perched water zones. The perched water zones are transient and are not capable of producing sufficient water for domestic or other uses.

6.5 Groundwater Classification and Basis

The INTEC is located above the SRPA. The eastern portion of the aquifer was granted sole source aquifer status by the EPA on October 7, 1991. Three categories of aquifer protectiveness are applied under Idaho regulations: (1) Sensitive Resources, (2) General Resources, and (3) Other Resources. Since no previous action to categorize the SRPA under state regulations has occurred, the aquifer defaults to the "General Resources" category. General Resource aquifers are protected to ensure that groundwater quality standards are not exceeded. State water quality standards are specified by the Idaho Groundwater Quality Rule, the Idaho Water Quality Standards, and Wastewater Treatment Requirements. Idaho's groundwater standards incorporate 10 CFR 20 Appendix B, Table 2 and 40 CFR 141 and 143.

7. SUMMARY OF SITE RISKS

7.1 Human Health Risk Evaluation

The purpose of a human health risk assessment (HHRA) is to evaluate potential adverse impacts to human health resulting from exposure to site-related radioactive and nonradioactive contamination. The HHRA approach and results are summarized in this section. First, Section 7.1.1 summarizes the conservative screenings performed to identify sites or sources of contamination and COPCs by media. Contaminated media evaluated in the HHRA at OU 3-13 include soil, groundwater, and air. The release sites sources, COPCs, and COPC concentrations for each of these media were evaluated independently, primarily due to the complexity of the groundwater evaluation and the number of soil sites. These screenings were summarized and the results were then used as input in the performance of the baseline HHRA. This assessment is summarized in Section 7.1.2. A somewhat different grouping of sites was used in the RI/BRA (DOE-ID 1997b); however, the risk results are presented herein by the seven groups described in Section 4 of this ROD.

7.1.1 Derivation of Exposure-Point Concentrations

Generally, the analytical results of the field investigations conducted since 1991 were used to estimate exposure point concentrations for each site-related chemical. This was accomplished by implementing the measures below for each retained site:

- Extract (by site) contaminant of potential concern (COPC) concentration data from the Environmental Restoration Information System (ERIS) or from appropriate information sources
- Eliminate data that were rejected per the method validation
- Eliminate data that indicated probable blank contamination
- Segregate quality control data (e.g., blanks, duplicates)
- Average duplicate results
- Assume nondetects are one-half the reported sample quantitative limit
- Aggregate data by individual COPC
- Aggregate COPC data by select depths, i.e., surface and surface + subsurface (see Table 7-1)
- Calculate the 95% upper confidence level (UCL) of the arithmetic mean for each COPC by select depths (EPA 1992a)
- Assess appropriateness of the 95% UCL versus maximum concentration (EPA 1992a)
- Select appropriate concentration estimate
- Calculate contaminant concentration and/or contaminant mass.

Table 7-1. Results of the site and chemical screening processes.

OU/Site	COPCs
3-01/CPP-61 PCB Spill in CPP-718 Transformer Yard-Radiological contamination	Cesium-137 Strontium-90 Technicium-99
3-02/CPP-23 CPP Injection Well	Osmium[a] Cesium-137 Europium-152 Europium-154 Strontium-90
3-02/CPP-37A CPP Gravel Pit #1	Arsenic Americium-241 Cesium-137 Cobalt-60 Neptunium-237 Plutonium-238 Strontium-90 Uranium-235 Uranium-238
3-02/CPP-37B CPP Gravel Pit #2	Aroclor-1260 Kepone[a] Arsenic Americium-241 Cesium-137 Iodine-129 Neptunium-237 Plutonium-238 Strontium-90 Uranium-235 Uranium-238
3-02/CPP-65 Sewage Treatment Plant	Will be evaluated only as a source of recharge to perched zones and SRPA.
3-03/CPP-67 CPP Percolation Ponds #1 and #2—Sediments	Americium-241 Cerium-144 Cobalt-60 Cesium-134 Cesium-137 Iodine-129 Neptunium-237 Plutonium-238 Plutonium-239/-240 Ruthenium-106 Antimony-125 Strontium-90

Table 7-1. (continued).

OU/Site	COPCs
	Tritium Uranium-234 Uranium-235 Uranium-238
3-05/CPP-14 Imhoff Tanks	Aroclor-1260 Benzo(a)pyrene Phenanthrene[a] Cadmium Cesium-137 Neptunium-237 Strontium-90 Uranium-235
3-05/CPP-14 Plant Site	Aroclor-1260 Americium-241 Cesium-137 Neptunium-237 Antimony-125 Strontium-90 Uranium-234 Uranium-235 Uranium-238
3-05/CPP-14 Drain Field	Phenanthrene[a] Arsenic Neptunium-237 Strontium-90
3-06/CPP-33 Contaminated Soil in the Tank Farm Area NE of CPP-604	Arsenic Americium-241 Cesium-137 Neptunium-237 Plutonium-238 Plutonium-239/240 Strontium-90
3-06/CPP-34 Soil Storage Area in the NE Corner of the ICPP	Arsenic Cesium-137 Neptunium-237 Plutonium-238 Strontium-90 Uranium-234 Uranium-238
3-06/CPP-40 Lime Pit at the Base of the CPP-601 Berm and French Drain—Radiological Contamination	Cesium-137
3-07/CPP-20 CPP-604 Radioactive Waste Unloading Area	Americium-241 Cesium-134 Cesium-137

Table 7-1. (continued).

OU/Site	COPCs
	Cobalt-60 Europium-154 Neptunium-237 Plutonium-238 Strontium-90 Technicium-99
3-07/CPP-25 Contaminated Soil in Tank Farm Area North of CPP-604	Americium-241 Cesium-134 Cesium-137 Cobalt-60 Europium-154 Neptunium-237 Plutonium-238 Strontium-90 Technicium-99
3-07/CPP-26 Contaminated Soil in Tank Farm Area Steam Flushing—Operation inside the Tank Farm perimeter	Americium-241 Cesium-137 Europium-154 Plutonium-238 Plutonium-239 Strontium-90 Uranium-234 Uranium-235
3-07/CPP-28 Contaminated Soil in the Tank Farm Area South of WM-181 by Valve Box A-6	Cerium-144 Cesium-134 Cesium-137 Cobalt-60 Europium-154 Neptunium-237 Plutonium-239 Plutonium-240 Plutonium-241 Plutonium-242 Ruthenium-106 Strontium-90 Tritium Uranium-234 Uranium-235 Uranium-236
3-07/CPP-31 Contaminated Soil in Tank Farm Area South of Tank WM-183	Cesium-134 Cesium-137 Cobalt-60 Europium-154 Plutonium-239/-240 Ruthenium-106 Strontium-90

Table 7-1. (continued).

OU/Site	COPCs
	Uranium-235
3-07/CPP-32W/E Contaminated soil in the Tank Farm area of Valve Box B-4	Cesium-137 Europium-154 Strontium-90
3-07/CPP-79 Tank Farm Release Near Valve Box A-2	Americium-241 Cesium-137 Plutonium-238 Strontium-90 Uranium-234 Uranium-235
3-07/CPP-83 Perched Water	Arsenic Chromium Americium-241 Strontium-90 Technicium-99 Tritium Uranium-234 Uranium-238
3-08/CPP-13 Pressurization of the Solid Storage Cyclone NE of CPP-13	Arsenic Zirconium[a] Cobalt-60 Cesium-134 Cesium-137 Europium-154 Strontium-90 Technicium-99
3-08/CPP-15 Solvent Burner East of CPP-605—Radiological Contamination	Thallium[a] Zirconium[a] Americium-241 Cesium-137 Europium-154 Neptunium-237 Plutonium-238 Plutonium-239/-240 Tecnicium-99 Uranium-235
3-08/CPP-27 Contaminated Soil in Tank Farm Area East of CPP-604 and CPP-33	Americium-241 Cesium-137 Europium-154 Neptunium-237 Plutonium-238 Plutonium-239/-240 Strontium-90 Uranium-235
3-08/CPP-35	Americium-241

Table 7-1. (continued).

OU/Site	COPCs
CPP-633 Decontamination Spill	Cesium-137 Europium-154 Plutonium-238 Plutonium-239 Strontium-90 Uranium-235
3-08/CPP-36 Transfer Line Leak from CPP-633 to WI-102	Americium-241 Cesium-134 Cesium-137 Europium-154 Plutonium-238 Plutonium-239 Potassium-40 Strontium-90 Uranium-234 Uranium-235 Uranium-238
3-09/CPP-01 Horizontal Settling Basin, and Vertical Settling Pit and Soil Adjacent to SW-048 Dry Well and CPP-303 Dry Well—Environmental Release.	Americium-241 Cobalt-57 Cobalt-60 Cesium-137 Europium-152 Europium-154 Europium-155 Plutonium-239 Strontium-90 Uranium-235
3-09/CPP-02 French Drain West of CPP-603	Suspected Cesium-137 Suspected Strontium-90 Suspected Tritium
3-09/CPP-03 Temporary Storage Area SE of CPP-603 Stockpiled Soil	Cesium-137 Europium-152 Strontium-90
3-09/CPP-04 and CPP-05 Contaminated Soil Around CPP-603 Settling Tank	Cerium-144 Cobalt-60 Cesium-134 Cesium-137 Europium-152 Europium-154 Europium-155 Uranium-235
3-09/CPP-06 Trench East of CPP-603 Fuel Storage Basin	Cesium-137 Strontium-90

Table 7-1. (continued).

OU/Site	COPCs
3-09/CPP-08 and CPP-09 CPP-603 Basin Filter System Line Failure and Soil Contamination Near NE Corner of CPP-603 South Basin	Cesium-137 Europium-152 Europium-154 Strontium-90 Uranium-235
3-09/CPP-10 CPP-603 Plastic Pipeline Break	Cobalt-60 Cesium-137 Europium-152 Europium-154 Europium-155 Strontium-90 Uranium-235
3-09/CPP-11 CPP-603 Sludge and Water Release	Arsenic Thallium[a] Cesium-137 Cobalt-60 Europium-154 Neptunium-237 Strontium-90
3-09/CPP-17a Soil Storage Area South of CPP Peach Bottom Fuel Storage Area	Cesium-137 Europium-152 Europium-154 Strontium-90
3-09/CPP-17b Soil Storage Area South of CPP Peach Bottom Fuel Storage Area	Cobalt-57 Cesium-137
3-09/CPP-19 CPP-603 to CPP-604 Line Leak	Arsenic Calcium[a,b] Americium-241 Cobalt-60 Cesium-134 Cesium-137 Europium-152 Europium-154 Europium-155 Niobium-95 Plutonium-239 Strontium-90 Uranium-235
3-09/CPP-22 Particulate Air Release South of CPP-603	Cesium-137 Strontium-90 Technicium-99
3-09/CPP-69 Abandoned Liquid Radioactive Waste Storage Tank CPP VES-SFE-20	Cobalt-60 Cesium-134

Table 7-1. (continued).

OU/Site	COPCs
	Cesium-137 Europium-152 Europium-154 Europium-155 Plutonium-239/-240 Antimony-125 Strontium-90
3-09/CPP-78 Contaminated Soil West of CPP-693, East of Dry Fuel Storage Area	Strontium-90
3-10/CPP-46 CPP-637 Courtyard Pilot Plant Release—Radiological Contamination	Cesium-134 Cesium-137 Strontium-90 Technicium-99
3-11/CPP-58W/E Subsurface release of contaminants associated with PEW spills and CPP PEW Evaporator Overhead Pipeline Spills	Americium-241 Cesium-137 Europium-154 Plutonium-238 Plutonium-239 Strontium-90 Uranium-235
3-12/CPP-80 CPP-601 Vent Tunnel Drain Leak (VT-300)	Chloride[a] Sulfate[a] Zirconium[a] Cerium-144 Cesium-134 Cesium-137 Europium-154 Europium-155 Plutonium-238 Plutonium-239/-240 Ruthenium-106 Antimony-125 Strontium-90
3-13/CPP-85 WCF Blower Corridor	Cobalt-60 Cesium-134 Cesium-137 Europium-154 Strontium-90
3-13/CPP-87 VOG Blower Cell Floor Drain/Sump and PEW Evaporator Feed Pump Cell	Arsenic Barium Cadmium Chromium Lead[a] Mercury Cobalt-60 Cesium-134

Table 7-1. (continued).

OU/Site	COPCs
	Cesium-137
3-13/CPP-88 Radiologically Contaminated Soils Map	Arsenic Thallium[a] Cesium-137 Strontium-90
3-13/CPP-89 CPP-604/605 Tunnel Excavation	Americium-241 Cesium-134 Cesium-137 Cobalt-60 Iodine-129 Neptunium-237 Plutonium-238 Plutonium-239/240 Strontium-90 Antimony-125 Uranium-234 Uranium-235
3-13/CPP-90 CPP-709 Ruthenium Detection	Benzo(a)pyrene Phenanthrene[a] Arsenic Thallium[a] Cobalt-58 Cesium-134 Cesium-137 Europium-155 Niobium-95 Strontium-90
3-13/CPP-91 CPP-633 Blower Pit Drain	Arsenic Manganese Thallium[a] Cesium-137 Strontium-90
3-13/CPP-92 Soil Boxes West of CPP-1617	Americium-241 Cesium-134 Cesium-137 Cobalt-60 Europium-152 Europium-154 Iodine-129 Neptunium-237 Plutonium-238 Plutonium-239/240 Strontium-90 Antimony-125 Uranium-234 Uranium-235

Table 7-1. (continued).

OU/Site	COPCs
3-13/CPP-93 Simulated Calcine Trench	Aluminum Mercury
3-13/Windblown Area (OU 10-06)	Americium-241 Cesium-134 Cesium-137 Potassium-40 Plutonium-238 Plutonium-239 Plutonium-240 Strontium-90 Uranium-233 Uranium-235

a. No toxicity value is available. This will be further discussed in the uncertainty section.

b. Calcium is further evaluated since its concentration is about 9.67 times greater than background concentrations.

7.1.2 Site/Source and Contaminant Identification

7.1.2.1 Soil. This section summarizes the identification of sites and COPCs assessed in the HHRA for soil contamination. First, the sites that were designated "No Action" or "No Further Action" in the Track 1, Track 2, or RI/BRA were eliminated based on whether the soil concentration exceeded the PRGs. These sites either: (a) contain no source of contamination, either through process knowledge or as a result of sampling activity; or, (b) contain no source of contamination because of remediation. All signed and pending decision statements were reviewed during the RI/BRA to ensure that the assumptions on which these recommendations were based remain valid (see Section 4.8). The second step of the site screening process was based on the results of previous risk evaluations. All sites for which preliminary risk evaluations using Track 1 or Track 2 methods have shown cancer risk or hazard levels to be less than 1×10^{-6} or an HI < 1.0, respectively, were eliminated from further evaluation. The contamination screening process was performed for each of the retained WAG 3 release sites. Historical sampling data were used to identify COPCs present in soils at the WAG 3 sites. The list of contaminants was reduced by eliminating contaminants with observed concentrations less than INEEL background concentrations, by eliminating contaminants with detection frequencies less than 5% (i.e., one detect in 20 samples equals a 5% frequency of detection) and without evidence of release at the site, and by consideration of whether or not the contaminant is an essential nutrient. Because substances that are essential nutrients can be toxic at high concentrations, the latter screening step was only applied at sites where essential nutrient concentrations are less than 10 times the background concentration. The results of the site and contaminant screening are presented in Table 7-1. Soil concentrations for assessment were then calculated for sites of concern as discussed in Section 7.1.3 of the RI/BRA (DOE-ID 1997b).

7.1.2.2 Groundwater. This section summarizes the identification of COPCs and sources, and the modeling to determine groundwater contaminant concentrations. Groundwater COPCs were identified using three steps. First, an initial set of contaminants was identified by comparing the maximum concentrations measured in the aquifer and perched water to the limiting concentration defined by either the water concentration based on a 1E-06 risk level, an HI of 1, or the applicable MCL. The second identification step designed and applied a screening process to evaluate the potential for groundwater contamination from contaminated soils. Soil contaminants were evaluated for their maximum risk in the alluvium pore-water, their propensity to infiltrate through the alluvium, and the predicted reduction in activity due to radioactive decay. These first two steps used field data presented in Section 5.1 of Appendix F of the OU 3-13 RI/BRA, including maximum observed concentrations of individual chemical species and the associated risk. The field data included: (1) sampling and analysis of aquifer and perched water, (2) service wastewater source logs, and (3) sampling and analysis of soil contamination. Contaminants of concern based on other factors such as water sample information and soil contamination screens, were identified in the third step. As a result, three nonradionuclides and 10 radionuclides were identified as COPCs in groundwater as shown in Table 7-2. The identification and evaluation of the contaminant sources for the groundwater pathway are discussed in Section 5.2 of Appendix F of the OU 3-13 RI/BRA (DOE-ID 1997b).

The contaminant transport modeling was limited to three nonradionuclides (arsenic, chromium, and mercury) and 10 radionuclides (Am-241, Co-60, Cs-137, H-3, I-129, Np-237, Total Pu, Sr-90, Tc-99, and combined uranium). Each COPC was incorporated in the model using the mass (radionuclide activity is converted to mass units) defined from the known releases, service waste, soil contamination, or TRA discharge to the aquifer. These contaminant mass sources were modeled as either a uniform release over a known time frame, a variable release over a known time frame, or a one-time release at a particular time. For the simulations, the plutonium isotopes were combined into a Total Pu run and the uranium isotopes are combined into a Total U run.

Table 7-2. Summary of the identified groundwater COPCs.

COPCs Based on Water Samples				
Aquifer Based COPCs	Additional COPCs Based on Perched Water	Additional COPCs Based on Soil Contamination	Additional COPCs Based on Other Considerations	Final List of the COPCs for the Groundwater Pathway
Am-241	None	Arsenic	Cs-137	Arsenic
H-3		Chromium	Mercury	Chromium
I-129		Co-60		Mercury
Np-237		U-235		Am-241
Sr-90		Pu-238		Co-60
Tc-99		Pu-239		Cs-137
u-234		Pu-240		H-3
U-238				I-129
				Np-237
				Total Pu
				Sr-90
				Tc-99
				Total U

The total mass or activity of the contaminants at the general source location was divided into more specific locations and given the best estimate of time during which the releases occurred. Table 6-1 and Figure 6-1 of Appendix F of the OU 3-13 RI/BRA report summarize source locations and simulation time frames for each of the contaminant sources. Section 7 of Appendix F of the OU 3-13 RI/BRA presents the vadose zone and aquifer simulation results. Table 6-4 of the OU 3-13 RI/BRA (DOE-ID 1997b) presents a summary of the results by COPC.

The aquifer transport simulation results consist of contour plots of the peak concentration at eight different time frames centered about the MCL, contours of either the HI or risk number, depending on applicability, for eight time frames centered on the 10^{-6} risk (or HI = 1), and the time history of the peak concentration and corresponding risk for the entire aquifer, for the Test Reactor Area footprint and the INTEC footprint. (TRA is an upgradient source of tritium and chromium to INTEC.) Tables 6-5 to 6-8 of the RI/BRA present result summaries by COPC.

Concentrations for each contaminant were calculated as maximum values to coincide with the 100-year future residential scenario time frame over the entire WAG 3 and therefore is the same regardless of location within the INTEC. This was the only scenario for which groundwater was considered a pathway. The risk calculated for the SRPA are on-Site risks. There are no projected off-INEEL impacts to downgradient SRPA users.

7.1.2.3 Air. Area-weighted concentrations were calculated using the soil concentration terms prepared for each group and site within INTEC that are presented in Sections 8 through 26 of the OU 3-13 RI/BRA (see Table 7-3 of this ROD). For the onsite worker scenarios, COPC concentrations in the 0- to 15-cm (0- to 0.5-ft) depth range were used. For the future residential scenario, COPC concentrations in soil in the 0- to 3.05-m (0- to 10-ft) depth range were used. The individual site concentrations were then used to estimate the contaminant air concentrations due to emissions that may result from multiple sites of concern within WAG 3. This methodology is presented in Section 7.1.3.2 and 27.2 of the OU 3-13 RI/BRA (DOE-ID 1997b). Each COPC concentration term was calculated as an

Table 7-3. COPC exposure-point concentrations in air.

	Current Onsite Worker		Future Onsite Worker		Future Onsite Resident	
COPCs	Fugitive Dust (mg/m^3 or pCi/m^3)	Volatiles (mg/m^3)	Fugitive Dust (mg/m^3 or pCi/m^3)	Volatiles (mg/m^3)	Fugitive Dust (mg/m^3 or pCi/m^3)	Volatiles (mg/m^3)
Aroclor-1260	—	—	—	—	1.9E-11	1.6E-13
Benzo(a)pyrene	1.5E-12	8.4E-16	1.5E-12	8.4E-16	1.6E-12	5.7E-16
Aluminum	—	—	—	—	7.1E-07	—
Arsenic	1.2E-09	—	1.2E-09	—	7.4E-08	—
Manganese	3.2E-09	—	3.2E-09	—	3.4E-09	—
Mercury	—	—	—	—	8.3E-10	—
Uranium	5.1E-09	—	5.1E-09	—	4.3E-09	—
Am-241	4.5E-06	—	3.9E-06	—	1.1E-05	—
Ce-144	4.6E-07	—	9.5E-46	—	1.3E-45	—
Co-57	4.4E-10	—	1.2E-50	—	1.7E-50	—
Co-58	—	—	—	—	—	—
Co-60	5.1E-06	—	1.0E-11	—	7.4E-11	—
Cs-134	1.5E-06	—	3.6E-21	—	8.5E-21	—
Cs-137	5.0E-04	—	5.0E-05	—	2.3E-03	—
Eu-152	1.3E-04	—	8.1E-07	—	2.4E-06	—
Eu-154	1.0E-04	—	3.9E-08	—	1.0E-07	—
Eu-155	1.4E-05	—	1.2E-11	—	2.2E-11	—
H-3	2.7E-07	—	9.7E-10	—	5.4E-09	—
I-129	3.1E-06	—	3.1E-06	—	1.2E-06	—
K-40	—	—	—	—	3.0E-07	—
Nb-95	4.4E-12	—	—	—	—	—
Np-237	1.3E-06	—	1.3E-06	—	1.4E-06	—
Pu-238	5.5E-06	—	2.5E-06	—	4.2E-06	—
Pu-239/240	1.7E-06	—	1.7E-06	—	3.2E-06	—
Pu-241	—	—	—	—	5.4E-07	—
Pu-242	—	—	—	—	3.8E-09	—
Ru/Rh-106	2.9E-07	—	4.6E-37	—	1.8E-37	—
Sb-125	1.7E-07	—	2.3E-18	—	1.8E-18	—
Sr-90	2.1E-04	—	1.9E-05	—	6.3E-04	—
Tc-99	6.4E-07	—	6.4E-07	—	1.6E-06	—
U-234	2.1E-06	—	2.1E-06	—	1.5E-06	—
U-235	5.6E-08	—	5.6E-08	—	5.8E-08	—
U-236	—	—	—	—	9.0E-11	—
U-238	1.7E-06	—	1.7E-06	—	1.4E-06	—

— Indicates that the contaminant is not a COPC in the medium or at the site.

7.1.2.4 average value over the entire WAG 3 are and therefore, the same value is used regardless of location within INTEC.

7.1.3 Human Health Risk Assessment

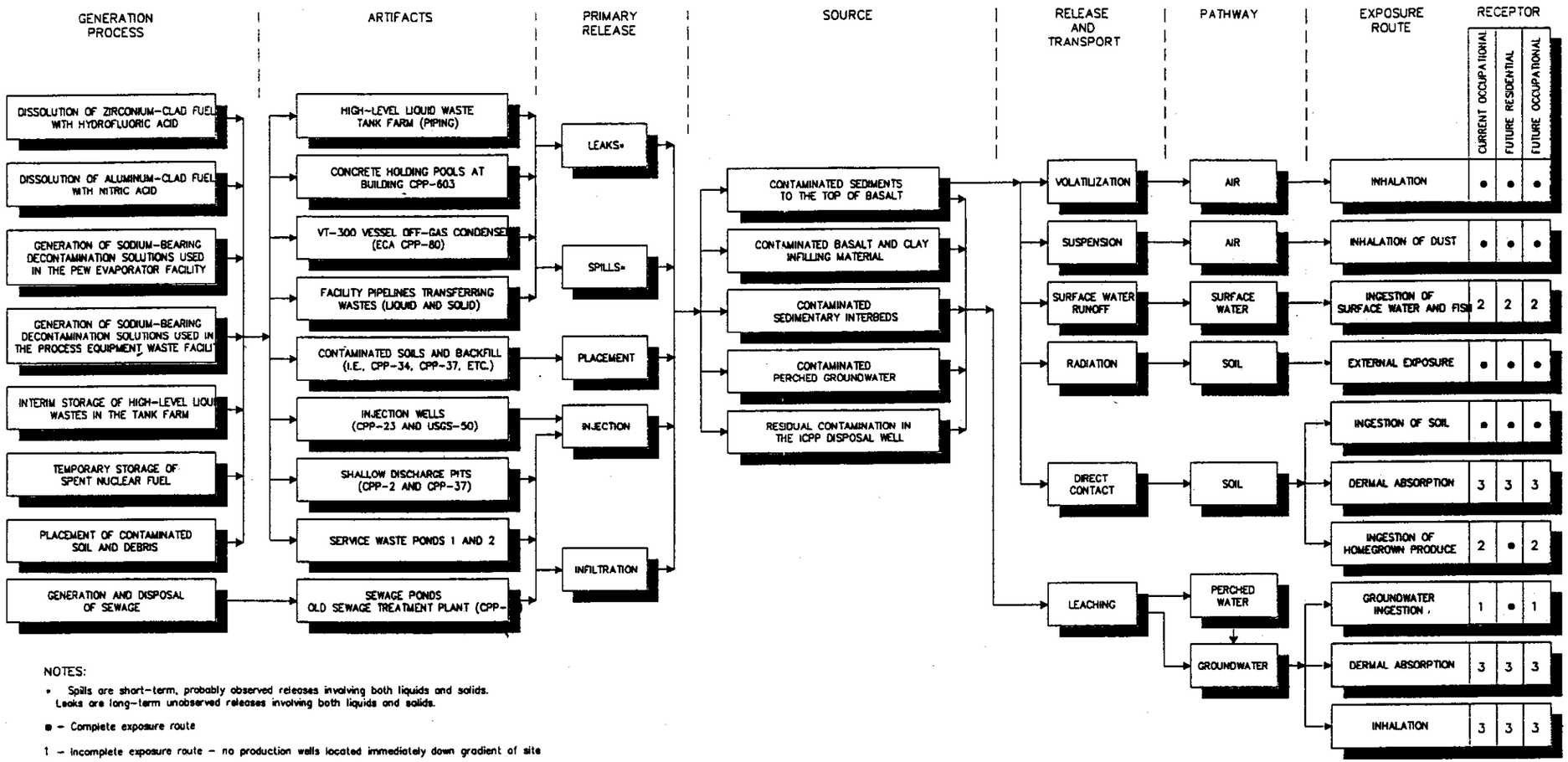
The OU 3-13 HHRA methodology is presented in Section 7 of the OU 3-13 RI/BRA (DOE-ID 1997b). This methodology was applied consistently for all retained sites within WAG 3. The HHRA evaluated risks due to exposure to COPCs through soil ingestion, fugitive dust inhalation, VOC inhalation, external radiation exposure, groundwater ingestion, ingestion of homegrown produce, dermal absorption of groundwater, and inhalation of water vapors during indoor water use. The approach is described in the following sections.

7.1.3.1 Exposure Assessment. The exposure assessment stage of the human health risk evaluation process estimates the exposure route, magnitude, frequency, and duration of exposures that receptors may experience due to contact with contaminants at a specific site or group of sites. The primary purpose of the exposure assessment is to estimate total dose for a receptor that can later be compared with chemical-specific dose response data to estimate cancer risk and the likelihood of other noncancer adverse health effects. A conceptual site model (CSM) was prepared to identify receptors and exposure routes under current and future land use conditions (Figure 7-1). The CSM illustrates the contaminant sources, primary release mechanisms, secondary sources and release mechanisms, exposure pathways, exposure routes, and receptors specific to WAG 3. Aspects of the exposure assessment process are described in more detail below.

7.1.3.2 Identification of Potentially Exposed Receptor Populations. The identification of potentially exposed receptor populations includes consideration of applicable current and future land use scenarios. A discussion of these scenarios at the INEEL is found in Section 7 of the BRA. As shown by the CSM, potential receptor populations include occupational site workers and hypothetical future residents. The current land use includes continued use of operating facilities. Access to these facilities is controlled; therefore, the only potential receptor is an occupational worker during the current land use scenario.

Because current industrial uses at WAG 3 are expected to continue in the future, the future land use scenario included occupational workers. Also, for the purposes of the WAG 3 HHRA, it was assumed that residential development may occur and thus, exposures to hypothetical future on-Site residents may occur and were evaluated. The residential receptor is assumed to be an adult for all potentially complete pathways; additionally, a child receptor was included in the soil ingestion pathway assessment. For this pathway, the child and adult parameters were averaged on a time-weighted basis. Child exposures were evaluated specifically for the soil ingestion exposure route because children have the potential for much greater exposure via this route. The timing for the future land use exposure scenarios was assumed to be 100 years in the future for both receptor populations.

7.1.3.3 Identification of Potential Exposure Pathways. The CSM for WAG 3 includes several exposure pathways and associated routes that were selected for further evaluation based on process and release history. The completeness of exposure pathways and routes are expected to vary between release sites according to the presence or absence of site-related chemicals or the presence of engineering features or artifacts that prevent exposure from taking place. Exposure pathways evaluated at each site of concern are summarized in Table 7-4. Site-specific features that influenced the completeness of pathways and exposure routes are described separately for each site in Sections 8 through 26 of the OU 3-13 RI/BRA.



NOTES:

* Spills are short-term, probably observed releases involving both liquids and solids.
Leaks are long-term unobserved releases involving both liquids and solids.

• = Complete exposure route

1 = Incomplete exposure route – no production wells located immediately down gradient of site

2 = Incomplete exposure route – pathway not present at site

3 = Incomplete exposure route – no COPCs present that can cause exposures by these exposure routes (see Section 7.1.3).

Figure 7–WAG 3 conceptual site model.

Figure 7-1. WAG 3 conceptual site model.

Table 7-4. Potentially complete exposure pathways quantitatively evaluated for WAG 3 and associated soil depths by exposure route.

Potentially Exposed Receptor	Scenario	Potentially Complete Exposure Pathways and Soil Depths by Exposure Route
Occupational worker	Current land use	Inhalation of VOCs (0-15 cm [0-6 in.])[a] Inhalation of airborne particulates (0-15 cm [0-6 in.])[a] Ingestion of surface soil (0-15 cm [0-6 in.])[a] External radiation (0-1.22 m [0-4 ft])[b]
Residential	Future land use	Inhalation of VOCs (0-3.05 m [0-10 ft])[c] Inhalation of airborne particulates (0-3.05 m [0-10 ft])[c] Ingestion of surface soil (0-3.05 m [0-10 ft])[c] Ingestion of homegrown produce (0-3.05 m [0-10 ft])[c] Ingestion of groundwater External radiation (0-3.05 m [0-10 ft])[c]
Occupational worker	Future land use	Inhalation of VOCs (0-15 cm [0-6 in.])[a] Inhalation of airborne particulates (0-15 cm [0-6 in.])[a] Ingestion of surface soil (0-15 cm [0-6 in.])[a] External radiation (0-1.22 m [0-4 ft])[b]

a. Exposure is assumed to be limited to surface soil. Surface soil is considered as the top 0-15cm (0-6 in.).

b. Exposure is assumed to be limited to the 0 to 1.22-m (0-4-ft) interval for undisturbed soil. Contamination below that depth is assumed to be shielded by the top soil.

c. Exposure is assumed to be possible for all contamination within the 0 to 3.05-m (0 to 10-ft) interval because of the excavation required for a basement. Conceivably, soils across the interval have the potential to become surface soil thus allowing exposure to occur to the hypothetical resident.

7.1.4 Toxicity Assessment

Toxicity values were used to assess potential adverse effects to humans from COPCs at WAG 3. A toxicity value is the numerical expression of the substance dose-response relationship used in the risk assessment. Toxicity values for the COPCs, consisting of slope factors for carcinogens, and reference doses for noncarcinogens, were obtained primarily from HEAST and the IRIS database. Slope factors and reference dose values are presented in Section 7.2 of the OU 3-13 RI/BRA (DOE-ID 1997b).

7.1.5 Human Health Risk Characterization

The human health risk characterization is presented as both cancer risk and noncarcinogenic hazard to a potential receptor. Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the HQ, which is the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose (RfD). A RfD is defined as a daily exposure level of a contaminant for humans that will not produce deleterious effects during a lifetime. By adding the HQs for all contaminants within a medium or across all media to which a given population may be reasonably exposed, the HI can be calculated. The HI expresses noncarcinogenic effects of multiple contaminant exposures within a single medium or across media. Potential carcinogenic risks are expressed as an estimated probability that an individual might develop cancer in their lifetime from exposure. This probability is based on projected intakes and chemical-specific, dose-response data called slope factors (SFs). Slope factors and the estimated daily intake of a compound, averaged over a lifetime of exposure, are used to estimate the incremental risk that an individual exposed to that compound may develop cancer.

7.1.5.1 Potential Human Health Risks Due to Soil Exposures. The intake equations used to calculate the scenario-specific intakes from contaminated soils are presented in Section 7 of the OU 3-13 RI/BRA (DOE-ID 1997b). These intakes and the available toxicity information were then used to estimate the increased cancer incidence and noncarcinogenic hazards. The results of the soil exposure risk calculations are presented by site in Sections 8 through 26 of the OU 3-13 RI/BRA (DOE-ID 1997b). As discussed below, these risks were evaluated cumulatively in Section 28 of the OU 3-13 RI/BRA (DOE-ID 1997b). There are no noncarcinogenic risks above unity for the future on-Site resident. The projected excess risk of incurring cancer for a future onsite resident from soil exposure is 2 in 100.

7.1.5.2 Potential Human Health Risks Due to Groundwater Exposures. The current cancer risk and noncarcinogenic hazard associated with ingestion of the contaminated groundwater by a future on-Site resident at the year 2095 are presented in the OU 3-13 RI/BRA (DOE-ID 1997b), Table 27-3. The predicted increased cumulative cancer risk due to all COPCs in groundwater south of the INTEC fenceline are 5 in 100,000, and exist only if no action is taken under OU 3-14. Plutonium is predicted to have a peak concentration of 36.2 pCi/L in the year 3085. The predicted activity and related risk was based on conservative groundwater transport modeling that will be further evaluated in the OU 3-14 RI/FS. The dermal and inhalation routes from groundwater exposure were evaluated, but were eliminated because the contaminants are not volatile and are not readily absorbed through the skin. Therefore, the risk associated with these exposure routes was determined to be insignificant.

7.1.5.3 Potential Human Health Risks Due to Air Exposures. The intake equations used to calculate the scenario-specific intakes from the inhalation of fugitive dust and volatilized contaminants are presented in Section 7 of the OU 3-13 RI/BRA. These intakes and the available toxicity information were used to estimate the increased cancer incidence and noncarcinogenic hazards (Tables 7-5 and 7-6). The results indicate that the increased cancer risk from exposure to area-weighted air concentrations is less than 1E-06 under all three scenarios. The noncarcinogenic hazard for this pathway was found to be well below a HI of 1 for all three scenarios. As discussed below, these risks were evaluated cumulatively in Section 27 of the OU 3-13 RI/BRA report (DOE-ID 1997b).

7.1.5.4 Cumulative Risk Presentation. Cumulative cancer risks and noncarcinogenic hazards associated with WAG 3 were estimated by summing all risk contributions across all pathways and exposure routes for all contaminants. Risk contributions from the groundwater and air pathways were added to risk contributions from the soil pathway at each group and site within WAG 3. The results are presented visually in Section 27 of the OU 3-13 RI/BRA (DOE-ID 1997b). From these results Tables 7-7 and 7-8 were developed. This table presents the COCs identified by the HHRA and the corresponding cancer risk for each group of sites by exposure scenario at WAG 3.

7.1.6 Human Health Risk Uncertainty

Many sources of uncertainty are introduced during the risk assessment process, beginning with site investigations and sampling and analysis through risk characterization. Site-specific uncertainty is discussed separately for each release site in Sections 8 through 26 of the OU 3-13 RI/BRA. A summary of uncertainty sources and their potential effects on the risk evaluation is given in the following paragraphs.

7.1.6.1 Exposure Pathways. Generally, pathways and exposure routes were evaluated in the OU 3-13 RI/BRA according to their potential risk contribution. Exclusion of less significant pathways may underestimate the total risk to human health. However, those pathways not quantified were estimated to represent small sources of exposure and were not expected to influence risk management decisions.

Many of the sites are rarely, if ever, visited by onsite workers. The actual exposure time is significantly lower than the values used in human health risk assessments (i.e., 10 hr/d) and therefore risk calculations likely represent an overestimate of the actual risk.

7.1.6.2 Contaminant Fate and Transport. With the exception of radionuclides, the evaluation of human health risks assumed that environmental media concentrations determined from sampling will remain at the same levels over the assumed periods of exposure. This assumption is likely to result in an overestimation of risk, since concentrations are expected to decline over the long-term as natural processes degrade, dilute, or remove site contaminants. The rate of the these natural processes in the contaminated media are unknown, therefore, the magnitude of the overestimate is difficult to determine.

7.1.6.3 Exposure-Point Concentration. The exposure-point concentrations used for assessing risks associated with the reasonable maximum exposure case were either the maximum detected value or the upper 95th percentile of the mean value (whichever is less). Nondetected values were treated as concentrations equal to half the detection limit. This procedure would overestimate the risk except in cases where the actual concentration of the chemicals is below the detection limits.

7.1.6.4 Exposure Levels. The amount of exposure that an individual receives is highly dependent on their activity patterns. There is considerable variability regarding the values assumed in calculating human intake factors. For instance, estimates of soil ingestion rates for all populations are subject to ongoing debate. This may again result in overestimating or underestimating the risk on an individual basis. Additionally, exposure levels estimated for this project did not take into account the fact that individuals such as onsite workers would be required to wear personal protective equipment (PPE) when working in contaminated areas. This results in an overestimation of risk for these potential receptors.

7.1.6.5 Cancer-Risk Estimates. The predicted cancer risk in humans due to chemical exposure (i.e., nonradiological) is often based on cancer dose-response data in animals. There is a long-standing controversy in the scientific community as to the best way by which cancer-dose response data obtained from animal studies should be extrapolated to humans. In general, the EPA follows a conservative procedure in deriving slope factors, so cancer risk estimates due to chemical exposure based on these values are likely considerably higher than the true risks.

7.1.6.6 Computer Modeling. A computer model was used to estimate exposure concentrations of site-related chemicals in groundwater. These values were subsequently used to estimate chronic daily intakes, and subsequent total cancer risk and noncarcinogenic hazard. Numerical predictions of contaminant fate and transport in the vadose zone and the aquifer were based on: (1) hydrogeologic data forming the conceptual models for both zones; (2) contaminant release source term estimates; and (3) estimates of the contaminant-soil-basalt chemical interactions. The uncertainty in the conceptual model and its parameterization was qualitatively assessed. This uncertainty may have lead to either an over estimation or under estimation of risk. Uncertainty in source term estimates, including the volume, mass and content; and in the interaction of the contaminant with the soil and basalt, parameterized as the distribution coefficient or K_d; cannot be quantified accurately. The predicted contaminant concentrations are much more sensitive to these latter two parameter values than the first. The uncertainty associated with the use of a computer model to estimate groundwater exposure concentrations is discussed in detail in Section 6 of the OU 3-13 RI/BRA.